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Current Opinion in Environmental Sustainability

Harnessing deep mitigation opportunities of urbanisation patterns in LDCs

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Cities offer enormous opportunities for climate action that would limit the temperature increase to 1.5 °C by 2100 above pre-industrial levels. For example, cities can act through planning and service delivery, bringing together residential, work and leisure in single spaces, and creating better connectivity between areas within and between cities. In Least Developed Countries (LDCs) cities offer multiple opportunities for low carbon innovations given that so much of the cities in LDCs are yet to be built and serviced. The development of high carbon strategies, on the other hand, poses the danger of long-term carbon lock-in and narrows the existing window of opportunity to act. This paper explores the low carbon opportunities and avoided future emissions that cities in LDCs can implement as part of their mitigation pathways. The paper makes the case that deep mitigation efforts in the context of LDCs will need to take place within the broader agenda of sustainable development, poverty reduction, and equity. Examples of transport, energy and low carbon urbanism are discussed as evidence that climate-resilient development, consistent with the 1.5 °C pathway, is already underway in some LDCs.

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Current Opinion in Environmental Sustainability 2018, **30**:82–88

This review comes from a themed issue on **1.5°C Climate change and urban areas**

Edited by **Karen Seto** and **Diana Ürge-Vorsatz**

For a complete overview see the Issue and the Editorial

Available online 22nd May 2018

Received: 6 July 2017; Revised: 18 December 2017; Accepted: 21 March 2018

https://doi.org/10.1016/j.cosust.2018.03.007

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Introduction

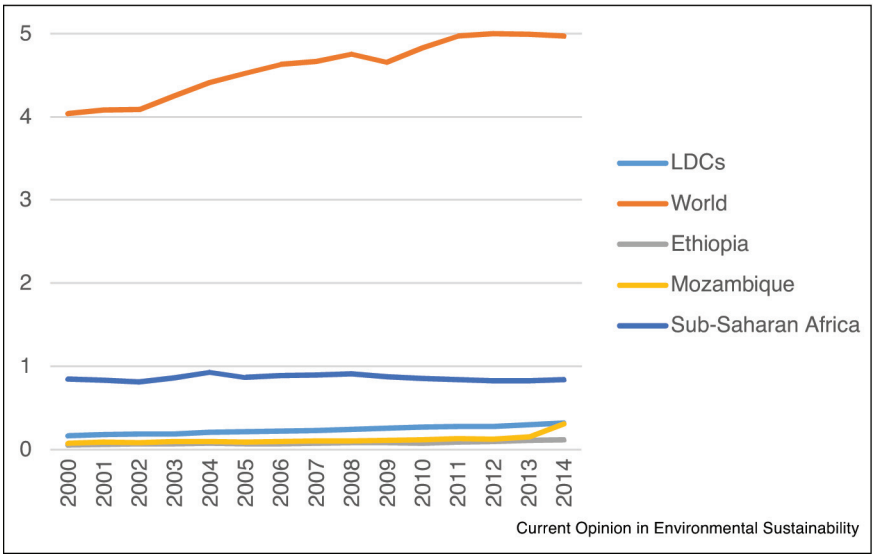
The central aim of the Paris Agreement is to strengthen the global response to keep a global temperature rise this century well below 2 °C above pre-industrial levels, and pursue efforts to limit temperature increase to 1.5 °C. The voluntary pledges in Nationally Determined Contributions (NDCs) are currently tracking towards a warming of 3–4 °C above pre-industrial temperatures [1]. Current efforts are insufficient to keep temperature changes under safe levels. Decarbonization at all levels is required. Deep decarbonisation requires a profound transformation of economic and energy systems [2••], fostered by catalytic, transformative strategies. Deep decarbonisation implies a realignment of current systems of production and consumption within global environmental limits. In this context, deep mitigation refers to the compendium of strategic actions that can deliver deep decarbonisation. The transformations required for deep decarbonisation may also have co-benefits for energy poverty and improving energy access, and hence, they could have a direct impact on enhancing wellbeing and livelihoods in many countries [2••].

The inclusion of the environmental law principle of "Common But Differentiated Responsibilities" (Principle 7 of the 1992 Rio Declaration) in climate agreements since the Kyoto Protocol reflects a concern with equity between countries in the Global South and Global North [3]. Over the past decade, however, discourses about the implementation of this principle and calls for global mitigation action has extended responsibilities for proportional mitigation action to every country [4]. In the current economic system, countries may object to the implementation of mitigation strategies if it does not address existing concerns or prevents less developed countries to use their natural resource endownments, for example [5]. In Least Developed Countries (LCDs) the relevance of deep mitigation strategies depends on their alignment with strategies designed to address pressing development concerns. Simultaneously, deep mitigation is about how the future is played out to the extent that the choices made today everywhere will likely have global implications. These observations raise the dilemma addressed in this paper: Is deep mitigation a burden for LCDs or an opportunity to foster alternative, sustainable futures?

The dilemma of deep mitigation in LDCs

The comparatively low rates of emissions per capita in LDCs compared with other country categories (Figure 1) have long supported the argument that mitigation in LDCs is inconsequential to achieve global emission reductions. Even considering the emissions in urban

Figure 1



CO_2 emissions (metric tonnes per capita) in Least Development Countries, World, Sub-Saharan Africa and selected countries (Data: World Development Indicators).

areas, where there are relatively high rates of energy and service access, the per capita emissions in LDCs are extremely low by global standards. For example, African urban emissions are estimated at 1.8 tCO_2 per capita, compared with the 15.6 tCO_2 per capita for North America, 6.9 tonnes for Western Europe, and 6.5 tonnes for China [6]. If emissions from South Africa and North African countries are omitted, the per capita emissions levels across the rest of urban Africa are reduced even further to under 0.5 tCO_2 per capita, suggesting that African cities have limited scope for influencing the current rate of global warming. Deep mitigation should not be a burden that LDCs carry without support. Such is the argument, for example, of defendants of 'development first,' which request the prioritisation of pressing development interventions to meet social and economic goals [7].

What happens if deep mitigation offers an opportunity to move society towards a sustainable pathway that delivers quality of life and better opportunities for citizens? For example, current rates of emissions do not reflect the significant levels of suppressed demand for services due to the persistence of precarious livelihoods, low income, poor infrastructure and inequalities in LDCs. Such suppressed demand represents a higher quantity of 'virtual' emissions locked into potential consumption if services are met via conventional technologies. Low carbon emissions, in this account, are a symptom of the political economy of LDCs and the marginal position LDCs occupy in the global economy. The aspiration within those countries is to achieve levels of autonomy, well-being, and opportunity comparable with those in countries with higher rates of historical and current emissions. Taking this into consideration, a scenario of increasing per capita emissions of the majority of LDC Africa's inhabitants to meet their basic needs is likely.

Long-term scales are central to examine deep decarbonisation pathways [8]. Lucas *et al.* [9] argue that without climate policy, Africa's energy-related CO_2 emissions are projected to increase by a factor of 7 to 50 between 2010 and 2100 — primarily driven by population growth and economic development, and the continued reliance of fossil fuel sources. Moreover, a slow transition from charcoal based household energy systems to clean and modern energy options combined with rapid urbanisation could contribute to higher energy-related CO_2 emissions [9]. Deep mitigation is an opportunity for LDCs to pioneer alternatives to deliver sustainable societies and economies, pursuing a different development pathway than industrialised and emerging economies.

In studies of urban adaptation to climate change there is a generalized acceptance that co-benefits represents an effective way to frame climate change policies and programmes [10,11]. The same argument pertains actions towards deep mitigation. In cities in less developed areas, interventions in sectors such as transport or waste can help achieve emission reductions and improved health outcomes simultaneously [12]. Mitigation actions in the energy sector and transport together have the potential to improve public health [13,14], reduce air pollution

[15,16], improve mobility and communications, and improve microclimates and habitability [17]. Mitigation has also been linked with economic benefits such as reductions in the unemployment rate [18]. Indeed, planning is a crucial means to bring together mitigation and adaptation actions while also enabling other co-benefits to address the structural determinants of both vulnerability and high carbon consumption [19,30]. The consideration of such co-benefits can have a catalyzing effect to facilitate low carbon development and investment in urban areas in LDCs [20••].

Technological, institutional and behavioural inertia create obstacles to the pace of change needed to bring countries in a deep mitigation pathway. For example, in 2016, fossil fuel financing still made up a significant proportion of the energy portfolio of the major multilateral development banks (MDB), with most of the transactions approved since the Paris Agreement [21]. This is in line with a previous report by Christian Aid [22] that challenged the notion of funding of fossil fuel projects for development because this approach relies on a false choice between addressing poverty and addressing climate. Not only low carbon development is a strategy to deliver energy access in previously unreachable areas, but also, LDCs have the potential to become leaders in low carbon innovation because their energy systems have room to innovate and experiment. The '1.5 °C pathway' represents a boundary to prevent impacts that would detract from poverty reduction and sustainable development efforts in LDCs.

The idea of 'leapfrogging' is one of the most compelling arguments for deep mitigation in LDCs. 'The New Climate Economy,' the flagship project of the Global Commission on the Economy and Climate chaired by Vicente Calderon, former president of Mexico, advances this idea [23]. In the report, the Commission argues that 'future economic growth does not have to copy the high-carbon, unevenly distributed model of the past' (p. 8). Instead, they ask a question about how to deliver investments that lead to 'better growth'. 'Better growth' is 'growth that is inclusive (in the sense of distributing its rewards widely, particularly to the poorest); builds resilience; strengthens local communities and increases their economic freedom; improves the quality of life in a variety of ways, from local air quality to commuting times; and sustains the natural environment' (p. 9). For other commentators, leapfrogging implies jumping out of the discourse of growth altogether: rather than decoupling economic growth from emissions, they recognise that we can decouple prosperity from economic growth [24••]. Virtually all the leapfrogging narratives invariably speak to the dynamics of innovation, involving technological, institutional and social innovation. The rapid adoption of mobile technologies and decentralised systems of energy production (such as solar home systems) are often invoked as evidence of the potential for leapfrogging in less-developed economies in Africa [25].

However, the question is to what extent these positive outlooks on deep mitigation merely reproduce western-inspired models of development without considering contexts in LDCs. Technological solutions for reducing emissions may not address the pressing development problems of LDCs [26]. Looking at low carbon transitions in six countries, Newell and Bulkeley demonstrate how the political economy shapes the possibilities of action, in a context in which there is no cohesive state managing the transition and enforcing rules [4]. Translating deep mitigation policies without deep analysis of their development benefits and costs across contexts may be grossly inappropriate in LDCs.

The New Climate Economy report, for example, suggests that cities and urban areas provide vital levers for climate action. Urbanisation in the 21st century is associated with land transformations (i.e., the increase of the urban land footprint per inhabitant) and increased consumption of natural resources and energy for the production of buildings and urban infrastructure [27]. There are indeed multiple and varied strategies to reduce carbon emissions in cities. However, urbanisation is also a multidimensional process which manifests differently everywhere. Reports such as this hardly represent examples of mitigation strategies in LDCs and reproduce a specific model of urban growth not always viable. The focus on 'what to do' leaves less space to tailor strategies to different contexts. Although the urban sustainability transition will involve radical changes anywhere, such changes will need to adjust to the specific conditions of implementation in urbanisation contexts [28].

In alignment with Elinor Ostrom's thesis on 'beyond panaceas,' the deep mitigation question is one in which the maxim 'no panaceas' holds significant meaning [29]. Indeed, deep mitigation opens up opportunities for LDCs, but only when the proposals for decarbonisation pathways relate to local aspirations and opportunities for co-benefits. From a global perspective, considering deep mitigation in LDCs requires going beyond asking 'what to do' in achieving deep mitigation to 'how to do it,' and how deep mitigation can be advanced in a manner that prioritises the well-being and the opportunities of citizens. To exemplify this, we engage with the question of deep mitigation in two contexts of urbanisation in LDCs.

Urbanisation and the opportunity for deep mitigation

To explore the complexities of deep mitigation and urbanisation in LDCs, we examine briefly two vignettes from Ethiopia and Mozambique. Ethiopia's ambitious growth and transformation plan (GTP), launched in 2011, has been running alongside the climate resilient

green economy (CRGE) strategy [30]. The rapidly expanding capital city and the secondary cities across the country are important arenas where this development-climate interplay is being negotiated. The transport sector is particularly relevant because transportation accounts for nearly 50% of the CO_2 emissions in Addis Ababa [31,32] — largely driven by increasing population and rapid spatial expansion of the city. The Light Rail Transit (LRT) Project in Addis Ababa symbolizes this challenge, emphasizing the need for increased investment in the high-level infrastructure of the city as part of the process of urban modernization. Supported by Chinese capital, the LRT system has two perpendicular tracks, each approximately 17 km long, and it is highly advantageous regarding users, with about of 60 000 passengers per hour [33]. One of its key defining features is that the trains are powered with electricity, and given the low emissions factor of the country's grid, the cumulative emission reduction potential of the LRT system is forecasted at 1.8 million tCO_2e by 2030 [33]. This technical outcome slots into a government narrative that continued investment in renewable energy technologies provides the means to decarbonize the rest of the economy. The project is widely considered to have provided an infrastructure boost and inspired an appetite for innovative and ambitious actions, but some outstanding challenges remain such as the long distance between pedestrian crossings and questions on how well the LRT infrastructure is integrated the existing transport system. More data and research is needed in order to accurately assess the development and climate impacts of this initiative.

In the city of Maputo, the capital of Mozambique, charcoal remains the main source of energy for the large majority of households, despite claims of the imminent transition to cleaner fuels. A locally-based NGOs called AVSI are delivering a cookstove improvement programme. They argue that the traditional iron cookstove used in Maputo is hardly more efficient than a simple three-stone fire. Qualitative research is one of the target neighbourhoods in Maputo shows that there is potential for cookstoves to provide better energy services to local households, reducing their fuel costs and the pollution associated with cooking. They have found some barriers to their improved cookstove replacement programme. The evidence points towards the mismatch between cooking practices, the built environment and the cookstove [34]. For example, some residents point out that the cookstoves are just too small. Others complain about imported cookstoves and the impact that may have on the local supply chain of cookstoves. In the past few years, the price of LPG has dropped, while the cost of charcoal has increased because of problems of supply. This structural change, however, has not translated directly into a transition towards LPG. What deep mitigation strategies are available in Maputo? The fact that LPG is considered a cleaner fuel in policy circles contrasts with the persistence of the use of charcoal among local residents, which they find familiar and reliable. Attempts to introduce alternative fuels, such as ethanol, have not prospered either. In urban Mozambique, as in other LDCs, charcoal may be a principal means whereby people claim energy justice against 'products of elite interpretations of modernist development ideology, excluding the voices of those involved in local fuel production and use' [35]. In this case, there is a need to understand the kind of technologies used and how they are embedded in everyday life. The extent to which improved cookstoves programmes contribute to deep mitigation is conditional to particular visions of the future in which there is little space to explore renewable or low carbon alternatives. In this case, low carbon action involving renewables beyond LPG can directly improve the lives of people by improving energy access and health outcomes [36].

The Africa's Urban Revolution goes beyond the relatively fast-paced growth of urban population and increased rate of land conversion in urban areas [37]. Such revolution entails a profound process of economic and social transformation deeply rooted in a history of inequality and colonial dominance [38••]. One example of the deeply contextual nature of urban change is the pretended link between urbanisation and economic growth in African cities. On the one hand, it seems that, if anything, economic processes foster spatial reconfiguration, rather than urbanisation being a force for economic growth [39]. Alongside positive scenarios emerge voices that caution against overlooking the impacts of urbanisation in specific locales. As Iván Turok has argued 'growth fuelled by harvesting Africa's natural resources will produce skewed outcomes, little employment where it is needed most, and inflated urban property prices that could crowd out expansion of other productive activities' [40].

Assessments such as the New Climate Economy report proposes models of compact and connected urbanism, mainly emphasizing the opportunities for spatial planning and coordination [23]. Although speaking of a uniform rate of rapid urbanisation everywhere, this approach does not reflect the various realities on the ground and the scale of urban change in the African LDCs [38••]. The assumption is that accelerated patterns of unguided urbanisation constitute a major threat to sustainable futures in LDCs in Africa [37]. However, the challenges related to urbanisation in Africa are often derived from the implementation of inappropriate models of colonial and postcolonial development rather than only from the actual lack of planning [41,42]. Sustainability and low carbon concerns — such as compact city models or models that increase connectivity — can motivate urban projects that not only do not match the needs of African cities but also, threaten the lives of those living in those cities [43]. Back to the vignettes above, in Addis Ababa the deep mitigation strategy is not the BRT per se, but rather, the

possibility of delivering better mobility options to its citizens through forms of public transport. Similarly, in Maputo, the question is not to provide improved cookstoves but rather, to understand local energy needs and why are they not met. In both cases, deep decarbonisation departs from within citizens' aspirations and their capacity to achieve them.

Deep mitigation creates new demands and scenarios for development planning in LDCs, but may not be possible without consideration of winners and losers, hidden costs, and the differential power within social and environmental outcomes of deep mitigation policies. Rather than asking what is deep mitigation, a more pragmatic question of how to achieve deep mitigation in every context emphasises the extent to which mitigation policies will also deliver better futures for all.

Deep development and deep mitigation

The opportunity to transition towards sustainable and just outcomes offers a reason for optimism in LDCs because alternative futures can develop in economies that are less locked in existing social and technological regimes [44,45].

For LDCs, remaining in their current low carbon state and transition towards climate-resilient pathways means embracing a contextualised vision of development. Firstly, deep mitigation transformations would need to happen alongside other major social and economic transformations to meet sustainable development goals. There is mounting evidence of migration, rapid economic growth, international investment and technological transformations across Africa [45,46]. The question is whether these transformations will be accompanied by parallel improvements for everyone in health and wellbeing, economic and educational opportunities, political stability, and environmental quality [47].

Secondly, deep mitigation strategies need to address the structural challenges faced by LDCs. Adaptation is related to development objectives, particularly development actions that address the underlying structural causes of vulnerability [48,49]. Similarly, mitigation is related to the structural conditions that permit societies to thrive, including opening up opportunities for social and technological innovation. The increasing blurred boundary between adaptation and mitigation points towards the need to bring an integrative perspective that emphasizes the deep transformations involved in adaptation, mitigation, and development, particularly when thinking of urban areas [27]. These interactions, however, have to be taken with caution as there is a risk of conflating development aid and climate policies, which may lead to a reduction of overall development budgets [49].

Thirdly, deep mitigation demands robust cross-sectoral conversations as a way to widen participation, create collective ownership and build consensus around decisions about development pathways. Opportunities for avoiding future emissions exist, and policymakers across the LDCs will have to adopt a reflexive and cooperative approach to policy and practice, often challenging their assumptions and entrenched institutional behaviours [50••]. LDC structural transformations will in many cases involve a massive capital injection in infrastructure. This opens both opportunities and risks for avoiding future costs of GHG mitigation and pollution abatement interventions [51•]. Moreover, infrastructure investment will not be always necessary and sufficient. There is an urgent need for alternative future visions of deep mitigation and sustainable prosperity that engage with the aspirations of LDCs from within the context in which such visions will be implemented. The dominance of models of mitigation based on narrow perspectives of development [52] creates obstacles to envisioning how a low carbon future would look like in LDCs.

Ultimately, the main question is whose views are prioritised in delivering both climate change mitigation and development. The debates leading up to the sustainable development goals show that achieving consensus about broader visions may be easier than establishing clear roadmaps towards action on the ground. The experience of development and its critique highlights the need to move away from simple notions of development as freedom from poverty and understand the wide range of aspirations that people have, including the right to self-determination [53]. The debates on the future of development, as articulated in the Sustainable Development Goals, suggest the need for a greater emphasis on addressing structural inequality and fostering social solidarity globally [54]. The incorporation of progressive notions of development, however, is not always accompanied by commensurate measures on the ground [28]. For example, the emphasis of elites in LDCs to pursue fossil-fuel reliant development by evoking the principle of 'right to development' could lead to unsustainable development outcomes in the long run.

Conclusion

We argue that deep mitigation is a prerequisite for limiting the long-term temperature goal to 1.5 °C above pre-industrial levels. Deep mitigation is not an objective but an ideal that can guide actions of sustainable development in different countries, as long as it is interpreted and redefined within the particular context of implementation. Linking deep mitigation and development aspirations in LDCs, particularly in Africa, is a means to increase resources and capacity for addressing the structural causes of vulnerability, and link resource consumption with improvements in wellbeing. Opportunities for deep mitigation are particularly salient in cities. The

examples in Ethiopia and Mozambique show that there are opportunities for countries to implement emissions avoidance policies in areas of mobility and energy services. However, the actual impacts of low carbon projects need to demonstrate a deeper development benefit in ways of improving quality of life directly. Deep mitigation strategies should be transformative, both in material terms (reducing emissions significantly) and in political terms (enabling the materialisation of bottom-up visions of development). In the context of the need to align action to advance the SDGs, there is an urgent need for research which engages with the practical consequences of low carbon transitions in LDCs and that prioritises, above all, the development of local visions to advance inclusive urban futures.

Conflict of interest statement

Nothing declared.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

1. UNFCCC: *Aggregate Effect of the Intended Nationally Determined Contributions: An Update*. UNFCCC; 2016:16-7126.

2. •• Ribera T, Sachs J, Colombier M, Schmidt-Traub G, Waisman H, Williams J, Segafredo L, Pierfederici R: *Pathways to Deep Decarbonization*. SDSN/IDDRI; 2015.
The report presents the analysis of how deep decarbonization can be compatible with development and economic growth. The report also highlights the importance of a major shift in investment from fossil fuels toward low-carbon technologies, and policies will play a pivotal role in cost reduction of technologies.

3. Cullet P: **Common but differentiated responsibilities**. *Res Handb Int Environ Law* 2010:161.

4. Newell P, Bulkeley H: **Landscape for change? International climate policy and energy transitions: evidence from sub-Saharan Africa**. *Clim Policy* 2017, **17**:650-663.

5. Keohane RO, Victor DG: **Cooperation and discord in global climate policy**. *Nat Clim Change* 2016, **6**:570.

6. Floater G, Rode P, Robert A, Kennedy C, Hoornweg D, Slavcheva R, Godfrey N: **Cities and the new climate economy: the transformative role of global urban growth**. *New Climate Economy Cities Paper 01*. LSE Cities. London School of Economics and Political Science; 2014.

7. Ayers J, Dodman D: **Climate change adaptation and development I: the state of the debate**. *Progr Dev Stud* 2010, **10**:161-168.

8. Bataille C, Waisman H, Colombier M, Segafredo L, Williams J: **The Deep Decarbonization Pathways Project (DDPP): insights and emerging issues**. *Clim Policy* 2016, **16(Suppl. 1)**:S1-S6.

9. Lucas PL, Nielsen J, Calvin K, McCollum DL, Marangoni G, Strefler J, van der Zwaan BCC, van Vuuren DP: **Future energy system challenges for Africa: insights from integrated assessment models**. *Energy Policy* 2015, **86**:705-717.

10. Turok I: *Linking Urbanisation and Development in Africa's Economic Revival*. Africa's Urban Revolution; 2014:60-81.

11. Carmin J, Anguelovski I, Roberts D: **Urban climate adaptation in the global south: planning in an emerging policy domain**. *J Plan Educ Res* 2012, **32**.

12. Roberts D, O'Donoghue S: **Urban environmental challenges and climate change action in Durban, South Africa**. *Environ Urban* 2013, **25**:299-319.

13. Younger M, Morrow-Almeida HR, Vindigni SM, Dannenberg AL: **The built environment, climate change, and health: opportunities for co-benefits**. *Am J Prev Med* 2008, **35**:517-526.

14. Anenberg SC, Schwartz J, Shindell D, Amann M, Faluvegi G, Klimont Z, Janssens-Maenhout G, Pozzoli L, Van Dingenen R, Vignati E: **Global air quality and health co-benefits of mitigating near-term climate change through methane and black carbon emission controls**. *Environ Health Persp* 2012, **120**:831.

15. Bollen J, Guay B, Jamet S, Corfee-Morlot J: *Co-benefits of Climate Change Mitigation Policies: Literature Review and New Results*. OECD Publishing; 2009.

16. Nemet GF, Holloway T, Meier P: **Implications of incorporating air-quality co-benefits into climate change policymaking**. *Environ Res Lett* 2010, **5**:014007.

17. Harlan SL, Ruddell DM: **Climate change and health in cities: impacts of heat and air pollution and potential co-benefits from mitigation and adaptation**. *Curr Opin Environ Sustain* 2011, **3**:126-134.

18. Altieri KE, Trollip H, Caetano T, Hughes A, Merven B, Winkler H: **Achieving development and mitigation objectives through a decarbonization development pathway in South Africa**. *Clim Policy* 2016, **16(Suppl. 1)**:S78-S91.

19. Puppim de Oliveira JA, Doll CNH: **Governance and networks for health co-benefits of climate change mitigation: lessons from two Indian cities**. *Environ Int* 2016, **97**:146-154.

20. •• Rashidi K, Stadelmann M, Patt A: **Valuing co-benefits to make low-carbon investments in cities bankable: the case of waste and transportation projects**. *Sustain Cities Soc* 2017, **34**:69-78.
The article provides a good discussion around the importance of considering co-benefits as drivers for low carbon investment. In LDCs, this is particularly important since the development benefits would create better buy-in by the policy and practice community.

21. Lee A, Doukas A: *Cross Purposes: After Paris, Multilateral Development Banks Still Funding Billions in Fossil Fuels*. Oil Change International; 2017.

22. Doig A, Adow M: *Low Carbon Africa: Leapfrogging to a Green Future*. Christian Aid; 2011.

23. New Climate Economy: *Better Growth, Better Climate: The New Climate Economy Report*. The Global Commission on the Economy and Climate; 2014.

24. •• Jackson T: *Prosperity Without Growth: Economics for a Finite Planet*. edn 2. Routledge; 2017.
The book summarizes the evidence showing that, beyond a certain point, growth does not increase human well-being, and argues for a redefinition of 'prosperity'. By setting out the framework for 'the economy of tomorrow', the book offers some sober ways forward for staying within the 1.5 °C goal.

25. Blimpo MP, Minges M, Kouamé WA, Azomahou TT, Lartey EKK, Meniago C, Buitano MM, Zeufack AG: *Leapfrogging: The Key to Africa's Development*. World Bank Group/China Investment Bank; 2017.

26. Mistry R: *MAPS Provocateur Briefing Report: Forum on Development and Mitigation Cape Town, Oxfam*. 2014.

27. Ayers JM, Huq S: **Supporting adaptation to climate change: what role for official development assistance?** *Dev Policy Rev* 2014, **27**:675-692.

28. Frediani AA: **Amartya Sen, the World Bank, and the redress of urban poverty: a Brazilian case study**. *J Hum Dev* 2007, **8**:133-152.

29. Ostrom E, Janssen M, Anderies MA: **Going beyond panaceas**. *Proc Natl Acad Sci* 2007, **104**:15176-15178.

30. Carter JG, Cavan G, Connelly A, Guy S, Handley J, Kazmierczak A: **Climate change and the city: building capacity for urban adaptation**. *Progr Plan* 2015, **95**:1-66.

31. FDRE – Federal Democratic Republic of Ethiopia: *Ethiopia's Climate-Resilient Green Economy*. EPA – Environmental Protection Agency; 2011.

32. Cirolia LR, Berrisford S: **'Negotiated planning': diverse trajectories of implementation in Nairobi, Addis Ababa, and Harare**. *Habitat Int* 2017, **59**:71-79.

33. Addis Ababa City Administration: *Addis Ababa Greenhouse gas Inventory 2012*. AA City Administration; 2015.

34. Castán Broto V: **Natural gas and climate finance**. *Clim Policy* 2016:1-14.

35. Munro P, van der Horst G, Healy S: **Energy justice for all? Rethinking Sustainable Development Goal 7 through struggles over traditional energy practices in Sierra Leone**. *Energy Policy* 2017, **105(Suppl. C)**:635-641.

36. Economist: *Sub-Saharan Africa Gets its First Metro: Addis Ababa has Opened the First Part of a New Light Rail System*. The Economist; 2015. September 22.

37. Pieterse E, Parnell S: *Africa's Urban Revolution in Context. Africa's Urban Revolution. S. Parnell and E. Pieterse*. ZED Books; 2014:1-17.

38. •• Castán Broto V: **Urban governance and the politics of climate change**. *World Dev* 2017, **93**:1-15.
This article demonstrates that governing experiences in cities are shaping the discourses of climate change governance as urban areas offer the sites for experimentation for new policies and technological innovations that contribute to mitigation objectives.

39. Frantzeskaki N, Castan Broto V, Coenen L, Loorbach D: *Urban Sustainability Transitions*. Routledge; 2016.

40. Potts D: **Debates about African urbanisation, migration and economic growth: what can we learn from Zimbabwe and Zambia?** *Geogr J* 2016, **182**:251-264.

41. Boudreaux K: **Urbanisation and informality in Africa's housing markets**. *Econ Affairs* 2008, **28**:17-24.

42. Watson V: **The planned city sweeps the poor away...': urban planning and 21st century urbanisation**. *Progr Plan* 2009, **72**:151-193.

43. Watson V: **African urban fantasies: dreams or nightmares?** *Environ Urban* 2014, **26**:215-231.

44. Calvin K, Shonali P, De Cian E, Mouratiadou I: **The effect of African growth on future global energy, emissions, and regional development**. *Clim Change* 2016, **136**:109-125.

45. Yu Z, Gibbs D: **Sustainability transitions and leapfrogging in latecomer cities: the development of solar thermal energy in Dezhou, China**. *Reg Stud* 2017, **20**:1-12.

46. Cilliers J, Hughes B, Moyer J: **African futures 2050 — the next forty years**. *Inst Security Stud Monogr* **(175)**:2011:102.

47. UNECA (United Nations Economic Commission for Africa): *Macroeconomic Policy and Structural Transformation of African Economies*. UNECA; 2016.

48. Ngepah N: **A review of theories and evidence of inclusive growth: an economic perspective for Africa**. *Curr Opin Environ Sustain* 2017, **24**:52-57.

49. Pelling M: *Adaptation to Climate Change: From Resilience to Transformation*. Routledge; 2010.

50. •• Solecki W, KSeto KC, Balk D, Bigio A, Boone CG, Creutzig F, Fragkias M, Lwasa S, Marcotullio P, Romero-Lankao P: **A conceptual framework for an urban areas typology to integrate climate change mitigation and adaptation**. *Urban Clim* 2015, **14**:116-137.
The paper provides a novel conceptual framework that integrates mitigation and adaptation perspectives and strategies. This enables cross-city comparisons using multi-dimensional climate change typology that takes account of underlying causes of GHG emissions and vulnerabilities to climate change.

51. • Cole DH: **Advantages of a polycentric approach to climate change policy**. *Nat Clim Change* 2015, **5**:114-118.
The paper proposes Ostrom's polycentric approaches to climate policy as they provide more opportunities for experimentation and policy learning over time. The approach could create the platforms for more intense communications and inteactions among emitting parties, based on mutual trust.

52. Bowen S, Fankhausen S: **Low carbon development for least developed countries**. *World Econ* 2011, **12**:145-162.

53. Pogge T: *Freedom From Poverty as a Human Right: Who Owes What to the Very Poor?* UNESCO; 2007.

54. Deacon B: **Social solidarity must replace poverty eradication in the UN's post-2015 development agenda**. *Poverty and the Millennium Development Goals: A Critical Look Forward*. 2016:203-228.